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OUTLOOK FOR SOVIET ENERGY

I. Introduction

The USSR is the only major industrial nation in the world that is self-sufficient in energy and likely to maintain this position for the foreseeable future. Furthermore, the USSR has become a substantial net exporter of fossil fuels to Communist and non-Communist countries. Oil sales to the West are the Soviet Union's largest single source of hard currency earnings, totaling some \$3 billion in 1975. Coal exports to the West -- about 8 million metric tons in 1975 -- earned about \$385 million in hard currency. The USSR is in the early stages of becoming a sizable net exporter of natural gas, although at the present time it imports more gas from Iran and Afghanistan than it exports to Western Europe.

Future growth in energy supply depends, however, on successful development of Siberian resources, as 80% of the reserves of primary energy lie east of the Urals. In the hostile environment of the northern part of West Siberia the USSR is confronted with difficult petroleum exploration and development problems and has begun to purchase western equipment and technology to upgrade the petroleum industry's technical capability.

III. Summary

Domestic production of energy, which accounts for 98% of the USSR's total energy supply, is scheduled to grow at an annual rate of 5.0% in 1976-80, slightly below the rate during 1971-75. Crude oil will continue to account for slightly more than two-fifths of total production. The share contributed by natural gas will rise to almost one-fourth by 1980, and coal's share will decline to just over one-fourth. Minor sources of energy, including hydroelectric and nuclear electric power, will account for the remaining Although a net exporter, few percent. /imports -- mainly of natural gas -- accounted for 2% of total energy supply in 1975; imports will still be of minor importance in 1980.

Exports of energy probably are expected to grow at about 4.9% per year in 1976-80, somewhat less than the 7.5% rate of 1971-75. The bulk will continue to go to other Communist countries. Although exports of natural gas will rise sharply, exports of crude oil and petroleum products will still account for about two-thirds of total energy exports in 1980. Domestic consumption of energy apparently is projected at about 5.0% per year, a slight drop from the 5.2% rate of 1971-75. This rate of increase appears to be consistent with the planned overall growth of the Soviet economy in 1976-80.

The USSR probably will not be able to meet the ambitious targets set for oil and gas production in 1980 but it is likely that lags also will occur in other sectors of the economy thus preserving the overall balance between energy supply and requirements.

The USSR has not as yet released its long-range plan (1976-90) but forecasts made by Soviet energy experts in the early 1970's projected energy requirements through 1990 at a growth rate about equal to the rate now set for 1976-80. These forecasts point to a further slowdown in the growth of crude oil production, continued rapid increases in natural gas production, and a slight acceleration in the rate of growth in coal production. A very rapid buildup in nuclear energy production probably will be planned for the 1980's, but its share in total energy supply will still be small in 1990.

III. Production Through 1980

1. Crude Oil

The plan calls for Soviet crude oil^{1/} production to reach 620-640 million tons in 1980.^{2/} This output will require a 4.8%-5.4% average annual rate of increase compared with the 6.8% attained during 1971-75. Annual

1. Includes gas condensate.

2. Pravda, 14 December 1975, p. 2.

production over the five-year period is to increase by 129-149 million tons, about the same as the 138 million ton increment achieved in 1971-75. In 1975 the USSR produced a record 491 million tons^{3/} of crude oil, 32 million tons more than in 1974. Nevertheless, the original 1975 goal of 505 million tons^{4/} was underfulfilled by almost 3%. (See Table 1.)

The Soviet oil production goal for 1980 appears over-optimistic. Output probably will approximate 590-600 million tons. Fulfillment depends on rapid development of West Siberian deposits, and on major improvements in equipment and technology for oil and exploration, development, and transport -- none of which appears likely in the time allotted.

West Siberia is to provide all of the production increases planned through 1980. Output is to rise from 148 million tons in 1975 to 300-310 million tons in 1980, yielding half of national oil production.^{5/} This new Siberian goal is considerably higher than an earlier one of 230-260 million tons quoted by various oil industry officials. Although West Siberia exceeded 1975 production

3. Izvestiya, 1 February 1976, p. 2; the figure includes 9.3 million tons of condensate (Ekonomika Neftyanoi Promyshlennosti #1, January 1976, p. 3.).

4. Gosudarstvennyi Pyatiletnii Plan Razvitiia Narodnovo Khozaystva na 1971-75 gody, Moscow, 1972, p. 102.

5. Pravda, 14 December 1975, p. 2.

TABLE J

USSR: PRODUCTION OF MAJOR SOURCES OF PRIMARY ENERGY, 1960, 1965, 1970-75, 1980 PLAN

Crude Oil/ (Million metric tons)	Natural Gas (Billion cubic meters)	Solid (Million metric tons)	Hydroelectric Power (Billion kWh)		Nuclear Electric Power (Billion kWh)
			1960	1965	
147.9 ^{3/}	45.3 ^{2/}	509.6 ^{4/}	50.9 ^{3/}	81.4 ^{3/}	NEGL.
242.9 ^{3/}	127.7 ^{3/}	577.7 ^{3/}	124.4 ^{3/}	1.4 ^{5/}	
353.0 ^{3/}	197.9 ^{3/}	624.1 ^{3/}	3.5 ^{6/}		
377.1 ^{3/}	212.4 ^{3/}	640.9 ^{3/}	126.1 ^{3/}	4.0 ^{8/}	
400.4 ^{3/}	221.4 ^{3/}	655.2 ^{3/}	122.9 ^{3/}	7.3 ^{9/}	
429.0 ^{3/}	236.3 ^{3/}	667.6 ^{3/}	122.3 ^{3/}	11.7 ^{10/}	
458.9 ^{3/}	260.6 ^{3/}	684.5 ^{3/}	132.0 ^{3/}	18.0 ^{11/}	
491	28.9	701	140	20	5/
1975 (original plan)	505	320	165	25	6/
1980 Plan	620-640 ^{2/}	400-435 ^{2/}	190	90	5/
1980-810 ^{2/}					

1. Including gas condensate.

2. Raw coal.

3. USSR, Tsentral'nnoye Statisticheskoye Upravleniye, Nardnoye Khozyaystvo SSSR v 1974 g., Moscow 1975, p. 215, 220-222.

4. Pravda, 1 February 1976, p. 1.

5. Estimate.

6. USSR, Gosvudarstvennyy Byulleten'nyy Plan Razvitiya Narodnogo Khozyaystva SSSR na 1971-75 gody, Moscow 1972, p. 98.

7. Pravda, 7 March 1976, p. 3.

8. Elektricheskye Stantsii, May 1973, p. 11; Teploenergetika, December 1974, p. 10.

9. Teploenergetika, June 1974, p. 10; Teploenergetika, December 1974, p. 10.

10. Elektricheskye Stantsii, January 1974, p. 2.

11. Elektricheskye Stantsii, April 1975, p. 13.

plans by almost 18%, available data on West Siberia oil-fields indicates that peak production capacity is about 270-290 million tons.^{6/} Some of these fields have already peaked, and others will peak before 1980. New fields are being discovered in West Siberia, but no giant fields have been found comparable to Samotlor, which has a production potential of 110-120 million tons. In 1975, the Director of the Main Administration for the Oil and Gas Industries in Tyumen' Oblast disclosed that the new oil deposits being discovered in West Siberia are much smaller than Samotlor. As a result, 7 new deposits must be developed each year compared with only 16 during the whole of the past 110 years.^{7/} West Siberian production of about 250 million tons in 1980 appears to be a reasonable estimate.

The West Siberian goal for 1980 may have been raised above earlier limits because the region exceeded planned output in 1975 and represented the only major source of substantial increase. Moreover, Soviet planners realize that many of the major oil fields in the Urals-Volga region are being depleted rapidly and that output from this major producing area cannot be maintained at present levels during the next five years. V.D. Shashin, Minister of

6. Geologiya Nefti i Gaza, #3, March 1973, pp. 22-28; Organizatsiye i Upravleniye Neftanoi Promyshlennosti, #12, 1974, p. 16.
7. Pravda, 11 June 1975, p. 3.

the Petroleum Industry, acknowledged the depletion problem when he stated that new production capacity during 1976-80 will have to average 100 million tons per year, two-thirds of which is to offset depletion.^{8/} This implies a drilling requirement to offset depletion during 1976-80 equivalent to that of the previous 12 years, indeed a formidable task in light of chronic shortfalls in meeting annual drilling goals.

In recent years the rate of discovery of new oil reserves has lagged behind increases in production. As early as 1972 Shashin pointed out that accelerated development of the oil industry after 1975 would be possible only if new oil basins equivalent to West Siberia could be discovered and exploited.^{9/} As a result, plans have been made for extensive exploration in East Siberia during 1976-80.^{10/} Given climate and logistic problems worse than in West Siberia, more complex geological conditions, and the lack of adequate geophysical equipment, it is unlikely that East Siberia will make a worthwhile contribution to Soviet oil supply before the mid-1980's.

Soviet offshore experience thus far has been limited

8. Neftyanoye Khozaystvo, #6, 1975, p. 6; Ekonomicheskaya Gazeta, #22, May 1976, p. 4.
9. Geologiya Nefti i Gaza, January 1974.
10. Sotsialisticheskaya Industriya, 13 September 1974, p. 2.

chiefly to the shallow waters of the Caspian and Black Seas where operations are conducted from trestles extending from the shore or "man-made islands". The USSR has only 4 mobile offshore platforms (jackups), all in the Caspian Sea; only one is capable of drilling in water depths up to 100 meters. Moving into deeper water in the Caspian and Arctic Seas, or in the Sea of Okhotsk off Sakhalin, will require Western equipment and know-how. Even with help, only small amounts of oil could be produced in these areas before 1980.

If, as now foreseen, a 3% to 8% production shortfall occurs in 1980, the USSR has several options. The most logical step would be to reduce the rate of increase in oil consumption. Substitution of coal for oil by large industrial users, such as thermal power plants, probably would be the first move. If the average annual rate of increase in oil consumption can be held to about 5% through 1980, instead of the 7%-7.5% of recent years, oil supplies should be adequate to meet domestic needs, increase deliveries to Eastern Europe, and maintain sales to the West near present levels. (See Table 2.)

2. Natural Gas

Soviet plans call for natural gas production in

TABLE 2
USSR: ESTIMATED OIL SUPPLY AND DEMAND
(million metric tons)

	<u>1965</u>	<u>1970</u>	<u>1974</u>	<u>1975</u>	<u>1980</u>
SUPPLY					
Production	242.9	353.0	458.9	490.7	590 ^{1/}
Imports	<u>1.9</u>	<u>4.6</u>	<u>5.4</u>	<u>7.6</u>	<u>15</u>
TOTAL	244.8	357.6	464.3	498.3	605
DEMAND					
Domestic Consumption	180.4	261.8	348.1	368.0	470 ^{2/}
Available for Export:	<u>64.4</u>	<u>95.8</u>	<u>116.2</u>	<u>130.3</u>	<u>135</u>
To Eastern Europe	22.4	40.3	58.7	63.3	75
To other Communist countries	6.5	10.2	13.0	14.4	15
To the West:	35.5	45.3	44.5	52.6	45
To Hard currency countries	11.5	32.0	30.8	38.6	35

1. Plan calls for output of 620-640 million tons.

2. Assumes an average annual increase of 5% during 1976-80.

NOTE: Sources for trade information (1965, 1970, 1974): Vneshnaya Torgovliya SSSR za 1965, 1970, 1974 god, Ministerstvo Vneshnei Torgovli SSSR, Moskva.

1980 to reach 400-435 billion cubic meters.^{11/} The average annual rate of growth required to meet this goal ranges from 6.7% to 8.5%, about the same as the 7.9% rate achieved during 1971-75. Annual production over the five-year period is to increase by 111-146 billion cubic meters, about 20-50 billion more than in 1971-75. Production of 289 billion cubic meters in 1975 was almost 10% below the original Five Year Plan target of 320 billion cubic meters and only slightly above the revised annual plan for 1975.

The Soviet gas industry has failed to meet production goals for the past decade largely because of inability to coordinate field development with construction and efficient operation of pipelines and gas treatment plants. In recent years depletion of some large, older fields in the western part of the country has also been a factor in plan underfulfillment. The present plan appears as optimistic as those of the recent past, and production in 1980 is unlikely to exceed 390 billion cubic meters. (See Table 3 for estimates of gas supply and demand.)

Fulfillment of the plan depends heavily on substantial production increases from West Siberia, major improvements in gas production and pipeline technology, and increased supplies of high-performance equipment, none of which

11. Pravda, 14 December 1975.

TABLE 3
USSR: ESTIMATED NATURAL GAS SUPPLY AND DEMAND
(Billion cubic meters)

	<u>1965</u>	<u>1970</u>	<u>1974</u>	<u>1975</u>	<u>1980</u>
SUPPLY					
Production	127.7	197.9	260.6	289.3	390 ^{1/}
Imports ^{2/}	0	3.6	11.9	12.4	15
TOTAL	127.7	201.5	272.5	301.7	405
DEMAND					
Domestic consumption	127.3	198.2	258.5	282.4	346
Exports	0.4	3.3	14.0	19.3	29
To Eastern Europe	0.4	2.3	8.5	11.3	33
To Western Europe	0	1.0	5.5	8.0	26
NET TRADE	0.4	-0.3	2.1	6.9	44

1. Plan calls for output of 400-435 billion cubic meters.

2. From Iran and Afghanistan.

NOTE: Sources for trade information (1965, 1970, 1974): Vneshnaya Torgovlya SSSR za 1965, 1970, 1974 god, Ministerstvo Vneshnei Torgovli SSSR, Moskva.

appears probable. The bulk of new gasfield development and pipeline construction is to be concentrated in the permafrost regions of northern Tyumen' Oblast in West Siberia. Gas reserves here are more than adequate to provide the 87-117 billion cubic meter production increase scheduled for this region. However, in recent years, output goals have not been met from producing fields where difficult climate and working conditions persist. Commercial gas production at Urengoy, the world's largest gas field, in West Siberia is not scheduled to begin until 1978,^{12/} but delays are likely in coordination of development and pipeline construction schedules.

The basic problem of past years -- failure to meet pipeline construction goals because of shortages of large-diameter pipe and ancillary equipment -- is likely to continue through the present plan period. Plans for 1976-80 call for construction of 35,000 kilometers of gas pipeline. This is about 2,000 kilometers more than was scheduled for 1971-75, when the goal was underfulfilled by about 1,000 kilometers. Most construction is to be of large-diameter, high-capacity lines operating at 75 atmospheres pressure. A substantial part of the necessary line pipe, valves,

12. Stroitel'naya Gazeta, 4 February 1976, p. 3.

turbines, and compressors will have to be imported from the West, either by hard currency purchases, or as part of contracts for delivery of Soviet gas.

3. Coal

The plan target for coal production of 790-810 million tons in 1980 is slightly lower than the 810-820 million tons forecast for that year by the Minister of the Coal Industry.^{13/} Its achievement will require an average annual rate of growth of 2.4% to 2.9% during 1976-80. This rate is slightly above the actual 2.3% annual rate of growth in 1971-75 and the 2.0% per year in 1961-70. About nine-tenths of the 89 to 109 million tons increase in output over the five-year period is to be obtained in the eastern regions of the country -- chiefly from (a) the Karaganda coal basin in Kazakh SSR, where output is to rise from 92 to 127 million tons, (b) the Kuznets basin in West Siberia (up from 137 to 161 million tons), and (c) the Kansk-Achinsk basin in East Siberia (up from 25 to about 40 million tons).^{14/} Output from the Donets basin in the Ukraine, where costs are high, is to increase only slightly in 1976-80 (up from 221 to 231-233 million tons).^{15/}

13. B.F. Bratchenko, Ugol', #6, 1971, p. 5.

14. B.F. Bratchenko, Ekonomicheskaya Gazeta, #2, January 1976, p. 4.

15. Pravda, 10 February 1976, p. 1.

The eastern regions are to account for all of the 50 million ton increase in surface mining operations, an increase that would bring the share of coal extracted by this less costly method to 34% in 1980, compared with 32% in 1975.^{16/}

The coal industry goal probably can be achieved without great difficulty. Soviet geologists have estimated total reserves of coal at 8.7 trillion tons.^{17/} Although explored reserves are only a small fraction of estimated total reserves, they nevertheless are extremely large in relation to projected output. Explored reserves in categories A + B + C₁ were claimed to be 452 billion tons as of January 1970, of which 275 million tons were considered economically exploitable reserves, one-half, or about 140 billion tons were estimated by the Soviets to be recoverable.^{18/} However, the availability of reserves apparently places limitations on expansion of coal production in the short-run. A leading Soviet fuel expert, Academician N.V. Mel'nikov stated in February 1975 that:

...in spite of the availability of huge total geological reserves, the scale of possible exploitation of coal reserves, especially in the next decade, is still limited by insufficient exploration of a series of basins and deposits.^{19/}

16. N.V. Mel'nikov, Ugol', #2, 1976, p. 39.
17. N.V. Mel'nikov, Energeticheskiye Resursy SSSR, Toplivno-energeticheskiye Resurcy, Moscow, 1968, p. 37.
18. Akademiya Nauk SSR i Ministerstvo Geologii SSSR, Geologiya Ugol'nykh Mestorozhdeniy, Vol. 2, Moscow 1971, p. 299.
19. N.V. Mel'nikov, Planovoye Khozyaystvo, Feb. 1975, p. 11.

Problems may also arise with respect to construction of new mines and reconstruction of existing mines. A decree issued by the Central Committee of the Communist Party in February 1976 noted shortages in mine construction in the Donets basin and called for corrective action by the Ministry of the Coal Industry and other responsible authorities.^{20/} Similarly, mine construction work was recently reported to be lagging in the Moscow coal basin.^{21/} Moreover, Minister of the Coal Industry Bratchenko complained, in a speech at the 25th Party Congress in March 1976 that Gosplan had not yet allocated funds for beginning construction of new projects in the Kansk-Achinsk basin.^{22/} In 1974, the latest year for which overall statistics are available on construction in the industry, the capital investment plan was fulfilled only 92%.^{23/} However, the record during the first three years of the Ninth Five Year Plan (1971-75) was only slightly better (an average of about 95%).^{24/} There have been complaints in the Soviet press about deficiencies in equipment production but the problem does not appear to represent a serious bottleneck.^{25/}

20. Pravda, 10 February 1976, p. 1.

21. Pravda, 28 December 1975, p. 3.

22. Pravda, 3 March 1976, p. 3.

23. Ugol', #4, 1975, p. 74.

24. Ugol', #4, 1974, p. 73; #4, 1973, p. 76; #4, 1972, p. 72.

25. Pravda, 14 September 1973, p. 2; Trud, 26 October 1974, p. 2; Izvestiya, 2 April 1975, p. 3.

A substantial amount of equipment for the development of production in the South Yakutsk coal basin is being imported from Japan under a \$450 million loan to be repaid by deliveries of coal.^{26/}

4. Electric Power

The Tenth Five Year Plan provides for production of 1,340-1,380 billion kwh of electric power in 1980. Only about one-fifth of the planned output will be primary energy provided by nuclear and hydroelectric powerplants, the remainder being secondary energy produced at thermal powerplants that burn fossil fuels. (See Table 4.) The planned increase in total power production -- 29% to 33% over 1975 -- is considerably less than the 40% increase in power production achieved in the Ninth Five Year Plan, and is the lowest projected rate of growth since World War II. At the same time, the new five-year plan provides for an increase of 35% to 39% in total industrial output, with an accelerated rate of mechanization of production processes and a substantial cut in the share of manual labor. These latter goals could only be accomplished by considerably increased electrification of industrial processes. Such increases in industrial electrification, along with

26. Japan Economic Journal, 2 July 1974, p. 4.

TABLE 4
USSR: ELECTRIC POWER PRODUCTION
(Billion kilowatt-hours)

	<u>1965</u>	<u>1970</u>	<u>1974</u>	<u>1975</u>	<u>1980 Plan</u>
Total production	506.7	740.9	975.8	1,038	1,340-1,380
of which:					
Hydroelectric	81.4	124.4	132.0	140 ^{1/}	190 ^{1/}
Nuclear	1.4	3.5	18.0	20 ^{1/}	90 ^{1/}

1. Preliminary estimate.

a planned increase in the share of total electric power allocated to the rural economy, appear to be incompatible with the reduced rate of growth in production of electric power, and contrary to the historic pattern of a faster growth rate for electric power production than for industrial output.

The goal for installation of new powerplant capacity during 1976-80 is 67,000-70,000 megawatts (MW), which is almost the same as the goal for the preceding five-year plan, of 67,200 MW. Installation of new capacity fell short in the previous plan, however, reaching only 58,000 MW or 86% of the goal.^{27/}

Nuclear power and hydroelectric power figure prominently in the plans for construction of new generating capacity, representing 40% of the total planned capacity, versus 22% in the previous five-year period.^{28/} The Soviet Deputy Minister for Power and Electrification, E.I. Borisov, stated recently that the Soviet Union is the only large industrial country in the world that bases its economic development totally on its own fuel-power resources. But in the future the increase in the power potential must be

27. Energetik, March 1976, p. 1.

28. Izvestiya, 4 May 1976, p. 2.

obtained from nuclear fuel, hydro resources, and low-cost open-pit coal.^{29/}

The plan provides for installation of 13,000-15,000 MW in nuclear powerplants during 1976-80. All of this new capacity will be in European areas of the Soviet Union, where shortages of fuel from local sources for conventional thermal powerplants have led to an increasingly tight electricity supply. The total capacity at nuclear powerplants is to reach 20,000 MW by the end of 1980, which assumes that 15,000 MW of new capacity will be placed in operation. This level will be difficult to achieve, because capacity to produce nuclear powerplant equipment is inadequate. Failure to put the Kursk and Armenian nuclear powerplants into operation in 1975 was blamed directly on the failure of the machine building industry to deliver the necessary components.^{30/} Nuclear machine building is to develop at an accelerated rate -- a large nuclear engineering works is now under construction in the North Caucasus area -- but for the next few years the industry undoubtedly will continue to be plagued with shortages of equipment and late deliveries. Should the goal for 20,000 MW of nuclear powerplant capacity be

29. Sovetskaya Rossiya, 7 April 1976, p. 2.
30. Pravda, 20 December 1975, p. 3.

reached by the end of 1980, 90-100 billion kwh of electricity could be produced in that year, or about 7% of total power production, compared with 2% in 1975.

The Soviet Union has tremendous hydroelectric power resources, the economic potential of which is equal to 1,095 billion kwh per year. At present only about 13% of this potential is being utilized, to generate about 14% of annual power production.^{31/} Extensive development of the hydro power potential is hindered by its regional distribution. Only 18% of the hydro resources are located in European areas of the USSR, which have the greatest economic development, the highest concentration of population, and consume about 80% of the power produced. In the current five-year plan period the Soviets plan to install 14,000 MW of new capacity at hydroelectric powerplants. About one-third will be located in the European part of the country, 48% in Siberia and the Soviet Far East, and 19% in Central Asia. Hydroelectric powerplants could produce about 190 billion kwh of electric power in 1980 and thus maintain their 14% share of electric power output.

Large-scale thermal powerplants will be built in the future in eastern regions of the Soviet Union where there

31. Gidrotehnicheskoye Stroitelstvo, Feb. 1976, p. 29.

are large deposits of coal that can be mined inexpensively by the open pit method. Two such powerplants will be built in the current five-year period, one in North Kazakhstan to use Ekibastuz coal and one in Siberia to use Kansk-Achinsk coal. About half of the new thermal generating capacity during this period, however, will be built in European areas of the country.

Prospects for meeting the 1980 plan for electric power output are tied to attainment of the plan for construction of new powerplant capacity. This in turn will be dependent upon the ability of the machine building industry to increase the production of powerplant equipment. The inadequacy of the planned goal for production of electric power apparently disturbs P.S. Neporozhnyy, Minister of Power and Electrification. In his speech at the 25th Party Congress of the Communist Party of the Soviet Union, he stated that at least 70,000 MW of new power capacities must be commissioned, including at least 15,000 MW of nuclear capacity, to insure the generation of 1,400 billion kwh in 1980. The higher production goal presented by Neporozhnyy represents an increase of 35%, instead of the officially planned increase of 29%-33%. Neporozhnyy pointed out that in the past few years demand for electricity has begun to exceed the commissioning of new electric power

capacity, a situation that is reducing the reliability of the nation's electric power supply.^{32/}

IV. Energy Supply and Requirements in 1980

1. Planned Supply

Domestic production of energy, which currently accounts for about 98% of the USSR's total energy supply, (production plus imports) is scheduled to increase to about 2.0 billion tons of standard coal equivalent (SCE)^{33/} by 1980 (see Table 5). This equates to an average annual growth rate of 5.0% in 1976-80, which is slightly less than the 5.2% and 5.7% growth rates achieved in 1971-75 and 1961-70.

Oil will continue to account for the largest share of domestic energy output, but the reduced rate of growth in oil production will mean that its share will no longer be rising. (See Table 6.) Natural gas, whose potential Soviet planners were slow to appreciate, will continue to gain in importance in the energy production mix, with a concomitant drop in the share accounted for by coal.

Nuclear electric power production, while growing rapidly, will constitute only a minor share of total energy production through 1980.

32. Pravda, 4 March 1976, p. 3.

33. Standard coal equivalent is defined as having a heat value of 7,000 kilocalories per kilogram.

TABLE 5
USSR: SUPPLY OF AND REQUIREMENTS FOR ENERGY, 1960-1980

Million metric tons of standard coal equivalent¹

	Actual ² / 1960	1970	Estimated 1975	Plan 1980
TOTAL SUPPLY	742	1,289	1,685	2,150
Production of fuel	692	1,223	1,593	2,020
Crude oil and condensate	211	503	702	900
Natural gas	254	234	345	500
Coal	373	433	491	560
Peat, shale, and fuelwood ³ /	54	53	55	60
Hydroelectric power ⁴ /	6	15	17	23
Nuclear electric power ⁵ /	NEG ₆	36	36	38
Other sources	11	14	32	40
Imports				
TOTAL REQUIREMENTS	742	1,289	1,685	2,150
Consumption	678	1,119	1,440	1,840
Exports	60	167	240	305
Additions to stocks	4	3	5	5

Footnotes to Table 5 -- USSR: Supply and Requirements for Energy, 1960-80

1. Standard coal equivalent has a heat value of 7,000 kilocalories per kilogram.
2. Narodnoye khozyaystvo SSSR v 1972, Moscow, 1973, p. 70.
3. Excluding fuelwood gathered by the population which might amount to as much as 30 million tons standard coal equivalent per year.
4. Converted at the rate of 123 grams of standard coal equivalent per kilowatt-hour (the heat value of electricity), which corresponds to the procedure in the Soviet statistical yearbook cited above. If hydroelectric power were converted at a rate corresponding to the average amount of fuel required to produce electricity in thermal powerplants, which is the practice in some countries, the figures for hydropower would be approximately tripled.
5. Nuclear electricity is not shown explicitly in Soviet statistics on fuel-energy balances and does not appear to be included in "other sources" because the total shown for other sources has remained virtually unchanged since 1965. Estimated values have therefore been added for nuclear electricity at a rate of 350 grams of standard coal equivalent per kilowatt-hour through 1975, 325 grams in 1980, and 300 grams in 1990. This conforms to the practice of the Organization for Economic Cooperation and Development, and apparently to the practice of at least some Soviet energy technicians.
6. Minor sources of primary energy, such as agricultural wastes, together with secondary sources such as coke oven and blast furnace gases.

TABLE 6
 USSR: DISTRIBUTION OF ENERGY PRODUCTION, BY SOURCE,^{1/}
 1960, 1970, 1975, 1980 PLAN
 (Percent)

	<u>1960</u>	<u>1970</u>	<u>1975</u>	<u>1980</u> Plan
Total energy production	100.0	100.0	100.0	100.0
Crude oil and condensate	28.9	39.4	42.5	42.7
Natural gas	7.4	18.4	20.9	23.7
Coal	51.0	34.0	29.7	26.5
Peat, shale, and fuelwood	7.4	4.2	3.3	2.8
Hydroelectric power	0.8	1.2	1.0	1.1
Nuclear electric power	NEGL.	NEGL.	0.4	1.4
Other sources ^{2//}	4.5	2.8	2.2	1.8

1. Calculated from data in Table 5.

2. Minor sources of primary energy, such as agricultural waste, together with secondary sources such as coke oven and blast furnace gases.

Imports accounted for only 2% of total energy supply in 1975 and no doubt are scheduled to be of minor importance in 1980. The USSR imports small quantities of natural gas from Iran and Afghanistan (14 million tons of SCE in 1974) and a small amount of coal from Poland (9 million tons of SCE in 1974). Crude oil procurement from Middle Eastern countries for export on Soviet account primarily to Eastern Europe and other Communist countries grew rapidly from 5 million tons of SCE in 1970 to 19 million tons in 1973. In 1974, however, this total dropped to 6 million tons of SCE, because Soviet sales of oil to non-Communist countries declined and more domestic oil was available for export. (For details of Soviet imports of fossil fuels in 1965, 1970, 1974-75, see Tables 1-4 in Appendix A.)

2. Requirements

The USSR has been a net exporter of oil in increasing amounts since 1955. Since the mid-1960's net exports almost doubled rising from slightly more than 62 million tons in 1965 to about 124 million tons in 1975, or an average annual rate of 7.1%. In recent years a larger share of Soviet oil exports has gone to other Communist countries, especially Eastern Europe, although oil sales to the West are the USSR's largest single source of hard

currency earnings. (See Table 1 of Appendix A.) Until the last few years almost all natural gas produced in the USSR was consumed domestically. Since 1970 increasing volumes have been exported to both Eastern and Western Europe that more than offset imports from Iran and Afghanistan. As domestic output of gas increases and the pipeline network expands, the USSR will increase its net exports of gas from the present level of about 8 billion cubic meters per year to 40-45 billion in 1980, and foreign exchange earnings from such sales will rise sharply. (See Table 2 of Appendix A.)

Soviet exports of coal and coke have averaged about 28-30 million tons during the past few years, with almost one-third of the total delivered to non-Communist countries to ~~exam~~ hard currency. (See Tables 3 and 4 of Appendix A.)

As shown in Table 5, planned exports of energy in 1980 are estimated to be 305 million tons of SCE. This amounts to an annual rate of growth of 4.9% during 1976-80, considerably less than the actual rate of growth of 7.5% during 1971-75. The figure of 305 million tons was derived from data on planned deliveries to CEMA countries in 1976-80, together with an estimate of the share of Soviet exports of energy scheduled to go to these countries in 1980. A breakdown of exports is presented in Table 7. Exports to CEMA countries are scheduled to rise by about

TABLE 7

USSR: EXPORTS OF ENERGY BY DESTINATION AND TYPE,
1970, 1974 AND 1980*Million metric tons of standard coal equivalent*

	<u>1970^{1/}</u>	<u>Actual 1974^{2/}</u>	<u>Estimated Plan 1980</u>
All Countries:			
TOTAL	167	212	305 ^{3/}
Crude oil and petroleum products	136	166	197 ^{4/}
Natural gas	4	17	73 ^{5/}
Coal and coke	27	29	35 ^{6/}
CEMA Countries:^{7/}			
TOTAL	85	119	183 ^{8/}
Crude oil and petroleum products	67	96	123 ^{4/}
Natural gas	3	7	40 ^{5/}
Coal and coke	15	16	20 ^{6/}
Other Communist countries:^{9/}			
TOTAL	7	9	13
Crude oil and petroleum products	5	7	9 ^{6/}
Natural gas	0	0	2 ^{5/}
Coal and coke	2	2	2 ^{6/}
Non-Communist countries:			
TOTAL	75	84	109 ^{4/}
Crude oil and petroleum products	64	63	65 ^{4/}
Natural gas	1	10	31 ^{5/}
Coal and coke	10	11	13 ^{6/}

Table 7 -- USSR: Exports of Energy by Destination and Type,
1970, 1974 and 1980

1. Vneshnyaya Torgovlya SSSR za 1970, Moscow, 1971.
2. Ibid, 1974, Moscow, 1975.
3. Based on the estimate that exports to CEMA countries are scheduled to account for 60% of the total in 1980. The comparable percentages for 1965, 1970, and 1974 were 43%, 51%, and 56%.
4. Residual.
5. Based on long-term contracts.
6. Estimated.
7. East Germany, Poland, Czechoslovakia, Hungary, Romania, Bulgaria, Cuba, and Mongolia.
8. Based on the statement that deliveries of "reference fuel" [SCE] to CEMA countries during 1976-80 would total about 800 million tons and that deliveries in 1975 totaled 130 million tons (FBIS, Daily Report, Soviet Union, 10 February 1976, p. D-3). The 1975 figure of 130 million tons was projected to 1980 at a rate of growth that made total deliveries for 1976-80 equal to 800 million tons. Deliveries are assumed to exclude exports of electric power, which in 1980 are planned to amount to 22 billion kwh, or 7.2 million tons of SCE, about 75% of which are to go to CEMA countries in Eastern Europe and 18% to Finland. In 1975, exports of electric power amounted to 11 billion kwh, or 3.7 million tons of SCE.
9. North Korea, North Vietnam, Yugoslavia, and Communist China.

7.2% per year in 1976-80, compared with 8.9% in 1971-75. Exports of natural gas will rise very sharply. Exports of crude oil and petroleum products, while rising moderately will still account for about two-thirds of total exports of energy in 1980. Deliveries of natural gas to non-Communist countries also are scheduled to rise swiftly. Little, if any, increase is to be expected in deliveries of crude oil and petroleum products to non-Communist countries.

Planned consumption of energy in 1980 is estimated (as the difference between planned production and net trade plus changes in stocks) to be 1,840 million tons of SCE (see Table 5). This would represent a 5.0% rate of growth in 1976-80, a slight drop from the 5.2% rate achieved in 1971-75. Such a planned level of consumption in 1980 would be generally consistent with a planned GNP (according to Western calculations) of 936 billion dollars (1973 prices) in 1980. The implied energy/GNP ratio of 1.97 kilograms of SCE per dollar is compatible with ratios that ranged from 1.87 to 2.08 in 1955-75 with no clearly discernable trend (see Appendix B). The estimated planned rate of growth in consumption does, however, appear to be rather high when compared with the planned rates of growth in electric power production in 1976-80. Electric power

production, as indicated above, is scheduled to grow at a rate of only 5.2% to 5.9% in 1976-80, compared with 7.0% in 1971-75. A possible explanation is that more emphasis is to be placed on direct use of fuels. This could represent an energy conservation measure as two-thirds of the heat value of the fuel is lost when conversion is made to electricity. Use of oil and gas as chemical raw materials will also be increasing rapidly.

Powerplants can be built to use almost any type of fuel, and the Soviets have shown evidence since 1974 of an intention to reverse or halt the trend of increased use of oil and gas in powerplants.^{34/} This is in part a reaction to the quintupling world prices for crude oil since September 1973. Other factors undoubtedly are the increased cost in the USSR of extracting and transporting natural gas and uncertainty about long-run supplies of both oil and gas.

At the 25th Party Congress in February-March 1976, Party Chairman Brezhnev deplored the use of fuel oil in

34. During 1961-70, the share of fuel oil in total fuel consumed by thermal powerplants increased from 7% to 22% and the 1971-75 plan called for a further increase to 25%. The comparable figures for natural gas are 12%, 26%, and 27%. Gas has been made available for powerplants primarily in the summer months when consumption by other consumers is reduced. Thus, during 1961-70 a majority of the powerplants in the European part of the USSR, the Transcaucasus, the Urals, Central Asia and in part of Kazakhstan, were reported to have been switched to a dual fuel supply system of either fuel oil and gas, or coal and gas. During 1971-75, powerplants to be put in operation in the European part of the USSR were to be based, for the most part, on oil and gas as the "most economic" types of fuel for these regions. (Energetika SSSR v 1971-75 godakh, Moscow, 1972, p. 171-174).

powerplants, indicating it would make better sense to (a) convert it into more valuable types of fuel, or (b) use it as a petrochemical raw material, or (c) export it.^{35/} Premier Kosygin told the Congress that in 1976-80 a group of large powerplants in the Urals and Volga areas would be converted from fuel oil to coal and that the "foundations are being laid for the further growth of our power capacity from water power, atomic fuel, and cheap coals."^{36/} The Minister of the Gas Industry added that a long-range plan must be devised to eliminate wasteful burning of natural gas as a boiler fuel.^{37/} Subsequent to the Congress, he noted that although the cost of producing and transporting gas had risen sharply in the last 10 years so that it was no longer a cheap fuel, huge quantities were still being used in powerplants and boilers.^{38/} Late in 1975 the Minister of the Oil Industry suggested an increase in domestic oil prices to reduce consumption.^{39/}

Early in 1974, a leading energy expert in the USSR, L.A. Melent'yev indicated that doubts about the future growth of oil and gas reserves had caused a lowering of

- 35. Pravda, 25 February 1976, p. 6.
- 36. Pravda, 2 March 1976, p. 5.
- 37. Pravda, 2 March 1976, p. 2.
- 38. FBIS, Soviet Union, 22 March 1976, p. S-1.
- 39. Pravda, 18 December 1975, p. 1.

long-range forecasts of oil and gas production. He recommended that more of the large thermal powerplants planned for the European part of the USSR and the Urals be designed to burn coal.^{40/} He subsequently stated that in the future there would be "relatively limited possibilities for obtaining natural gas and particularly residual fuel oil" for thermal powerplants and boilers.^{41/}

Despite these statements, a reduction in the amount of oil and gas used in powerplants is unlikely to occur in 1976-80, although their share in powerplant energy use may decline. Fuel requirements for these powerplants are to rise by approximately 65 million tons of SCE by 1976-80, an amount not likely to be fully covered by increased coal production. The 1980 plan for coal production, which as indicated above is slightly lower than was forecast in 1971, calls for an increase of about 100 million tons (70 million tons of SCE) compared with 1975. Of this increment, almost 10 million will be required for production of coke. Unless gas or oil is substituted for coal in other uses, the most important of which is communal and household use, some increase must be scheduled to take

40. L.A. Melent'yev, Izvestiya Akademii SSSR, Energetika i Transport, May-June 1974, p. 15.

41. L.A. Melent'yev, Teploenergetika, No. 11, November 1974, pp. 7-8.

place in the consumption of oil and/or gas in thermal power-plants.

3. Prospects

As indicated previously, the plan for coal probably can be met without great difficulty, but it seems unlikely that the USSR will be able to attain the ambitious targets set for oil and natural gas. The shortfall probably will amount to 2-5% of planned total output of energy.

If the Soviet economy were to grow at the planned rate, the lag in oil and gas production might cause some inconvenience and necessitate some belt tightening on domestic consumption or adjustments in foreign trade in energy. If consumption growth of oil cannot be slowed, the Soviets must either cut exports to Eastern and/or Western Europe or increase imports of OPEC oil. The USSR is heavily committed to providing the bulk of Eastern Europe's oil supply and the need for hard currency militates against large reductions in sales to the West. Because large direct purchases would be limited by hard currency shortages, the Soviets probably would seek to get OPEC oil by barter, perhaps for military equipment. With respect to natural gas the Soviets probably would seek to avoid a reduction in exports, especially to Western Europe, as they cannot

afford loss of foreign exchange earnings. Some additional gas could be imported from Iran and Afghanistan to supplement indigenous output and to maintain exports. It is more likely, however, that lags will occur in other sectors of the Soviet economy as well, thus preserving the overall balance between energy supply and requirements. In any case, the shortfall in total energy output probably will not be significantly different from the estimated 3% shortfall that occurred in the 1971-75 plan period without serious damage to the economy.

V. Energy Requirements and Supply in 1990

The 15 year plan (1976-90) has not been released as yet. Some indication of its contents is available from fragmentary information published in the Soviet press on long-range forecasts made by Soviet energy technicians in the early 1970's as contributions to the formulation of this plan.

1. Requirements

Total energy requirements for 1990, as shown in Table 8, have been forecast at 3.5 billion tons of SCE, which amounts to a growth rate of 5.0% per year during 1976-90 -- about the same rate as is estimated to have been projected in the Tenth Five-Year Plan (1976-80). This

TABLE 8

USSR: REQUIREMENTS FOR AND SUPPLY OF ENERGY,
 1975, 1980, 1990
(Million metric tons of standard coal equivalent^{1/})

	Estimated 1975	Plan 1980 ^{2/}	Forecast 1990 ^{3/}
Total Requirements	1,685	2,150	3,500
Consumption	1,440	1,840	2,950
Exports	240	305	540
Additions to stocks	5	5	10
Total Supply	1,685	2,150	3,500
Production fo fuel	1,593	2,020	3,140
Crude oil and condensate	702	900	1,100
Natural gas	345	500	1,100
Coal	491	560	870
Peat, shale, and fuelwood	55	60	70
Hydroelectric power	17	23	35
Nuclear electric power	7	29	175
Other sources ^{4/}	36	38	50
Imports	32	40	100

1. Standard coal equivalent has a heat value of 7,000 kilocalories per kilogram.
2. Data from Table 5.
3. CIA Research Aid, Soviet Long-Range Energy Forecasts, A(ER) 75 71, September 1975.
4. Minor sources of primary energy, such as agricultural waste, together with secondary sources such as coke oven and blast furnace gases.

figure, together with data presented by Soviet delegates at the World Energy Conference (WEC) in 1974, indicate growth rates of 4.9% for consumption and 5.6% for exports. Again, these are close to the rates implied by the estimates for 1980 given in Table 5. However, the annual growth rate implied by the WEC data for energy inputs to electric power production was 7.2%, compared with a projected rate of only about 4.9% in the 1976-80 plan. As indicated in the previous section, the Soviets may now be planning to place greater emphasis on direct use of fuel as an energy conservation measure.

2. Supply

The figures for 1990 shown in Table 8 point to a further slowdown in the growth of production of crude oil after 1980, a continued rapid growth in natural gas production, and some acceleration in the rate of growth of coal production. The data also indicate very rapid growth in nuclear energy production in the 1980's although its share in total energy supply will still be small by 1990. The energy production mix as of 1990 would then compare, as shown in Table 9, with the situation in 1975 and in the 1980 plan.

A recent statement by Minister of the Coal Industry Bratchenko suggests, however, that the target for coal

production in 1990 may be substantially lower than the figure given in Table 5 of 870 million tons of SCE, or 1.3 billion tons of coal in its natural state. In late 1975, Bratchenko stated that output of coal would "possibly reach" 1 billion tons in 1990.^{42/} If 1 billion tons is the current target for 1990 it means that targets for one or more of the other energy sources -- most likely natural gas -- will turn out to be higher than indicated in Table 5, and/or that the projected target for total energy requirements (consumption plus exports) has been lowered. In any case, it seems likely that the planned rate of growth of energy requirements in the 1980's probably will turn out to be moderately lower than the rate apparently planned for 1976-80.

42. New Times, #44, October 1975, p. 5.

TABLE 9

USSR: DISTRIBUTION OF ENERGY PRODUCTION, BY SOURCE,
 1975, 1980, 1990^{1/}
 (Percent)

	<u>1975</u>	<u>1980 Plan</u>	<u>1990 Forecast</u>
Total energy production	100.0	100.0	100.0
Crude oil and condensate	42.5	42.7	32.4
Natural gas	20.9	23.7	32.4
Solid fuels	33.0	29.1	27.6
Hydroelectric power	1.0	1.1	1.0
Nuclear electric power	0.4	1.7	5.1
Other sources ^{2/}	2.2	1.7	1.5

1. Calculated from data in Table 8.

2. Minor sources of primary energy, such as agricultural waste, together with secondary sources such as coke oven and blast furnace gases.

APPENDIX A

TABLE 1

USSR: OIL TRADE
(Million metric tons)

	1965	1970	1974	1975
EXPORTS	64.4	95.8	116.2	130.3
Total	64.4	95.8	116.2	130.3
To Communist countries	28.9	50.4	71.7	77.7
Eastern Europe	22.4	40.3	58.7	63.3
Cuba	4.7	6.0	7.6	8.1
Yugoslavia	1.0	2.7	3.8	4.4
Other	0.8	1.4	1.6	1.9
To non-Communist countries	35.5	45.4	44.5	52.6
Western Europe	22.7	38.0	37.7	44.0
Finland	4.5	7.8	9.2	8.8
France	1.6	2.5	1.5	3.4
Italy	7.3	10.2	6.8	6.9
Sweden	2.8	4.8	3.0	3.4
West Germany ¹	3.1	6.3	6.9	7.6
Other	3.4	6.4	10.3	13.9
Near and Middle East	2.3	3.0	1.4	2.4
Egypt	0.8	1.6	0.2	0.2
Greece	1.2	0.9	1.0	1.9
Other	0.3	0.5	0.2	0.3
Africa	1.1	1.3	1.2	1.0
Ghana	0.6	0.5	0.3	0.1
Morocco	0.4	0.7	0.6	0.6
Other	0.1	0.1	0.3	0.3
Asia	6.1	3.1	2.6	2.9
India	1.4	0.3	1.0	1.2
Japan	2.9	0	0	0
Other	0.8	0.1	0.4	0.2
Latin America	3.3	0	1.2	1.5
Argentina	0.9	0	0	0
Brazil	2.4	0	1.2	1.5
North America	0	0	0.4	0.8
Canada	0	0	0.2	0.2
United States	0	0	0.2	0.6
Exports to hard currency countries	23.5	32.0	30.9	38.6
Hard currency earnings (\$ billion)	0.23	0.41	2.56	3.2
IMPORTS				
Total	1.9	4.6	5.4	7.6
Iraq	0	0	3.9	5.3
Algeria	0	0	0	1.0
Egypt	0	2.0	0.2	0.2
Romania	1.6	0.5	0.5	0.5
Other	0.3	2.1	0.8	0.6

1. Includes West Berlin.

SOURCES: Ministerstvo vnesheini Torgovli SSSR, Vneshnyaya Torgovlya SSSR za 1965, 1970, 1974, 1975 god, Moskva.

APPENDIX A

TABLE 2

USSR: NATURAL GAS TRADE
(Billion cubic meters)

	1965	1970	1974	1975
EXPORTS				
Total	0.4	3.3	14.0	19.3
To Eastern Europe	0.4	2.3	8.5	11.3
Bulgaria		0.3	0.3	1.2
Czechoslovakia		1.0	2.9	3.7
East Germany		0.0	0.6	3.3
Hungary		0.4	2.1	2.5
Poland		1.0	2.1	2.5
To Western Europe	0	1.0	5.5	8.0
Austria		1.0	2.1	1.9
Finland		0.0	0.4	0.7
Italy		0.0	0.8	2.3
West Germany		0.0	2.2	3.1
IMPORTS				
Total	0	3.6	11.9	12.4
Afghanistan		2.6	2.8	2.8
Iran	0	1.1	3.1	3.6
Net hard currency earnings (\$ million)	0	7.0	-89.0	52.5

SOURCE: Ministerstvo Vneshnei Torgovli SSSR, Vneshnyaya Torgovlya SSSR za

APPENDIX A
 TABLE 3
 USSR: COAL TRADE
 (Million metric tons)

	<u>1965</u>	<u>1970</u>	<u>1974</u>	<u>1975</u>
EXPORTS				
Total	<u>22.4</u>	<u>24.5</u>	<u>26.2</u>	<u>26.1</u>
To Communist countries	<u>14.8</u>	<u>14.7</u>	<u>16.4</u>	<u>16.5</u>
Eastern Europe	<u>13.6</u>	<u>13.0</u>	<u>14.8</u>	<u>14.8</u>
Other ^{1/}	<u>1.2</u>	<u>1.7</u>	<u>1.6</u>	<u>1.7</u>
To non-Communist countries	<u>7.6</u>	<u>9.8</u>	<u>9.8</u>	<u>9.6</u>
Western Europe	<u>5.5</u>	<u>4.6</u>	<u>5.9</u>	<u>5.5</u>
Austria	<u>0.8</u>	<u>0.8</u>	<u>0.8</u>	<u>0.8</u>
Belgium	<u>0.3</u>	<u>0.3</u>	<u>0.4</u>	<u>0.2</u>
Denmark	<u>0.5</u>	<u>0.5</u>	<u>0.3</u>	<u>0.4</u>
Finland	<u>0.7</u>	<u>0.5</u>	<u>0.5</u>	<u>0.5</u>
France	<u>1.6</u>	<u>1.5</u>	<u>1.6</u>	<u>1.7</u>
Italy	<u>1.0</u>	<u>2.0</u>	<u>1.6</u>	<u>1.2</u>
Sweden	<u>0.4</u>	<u>---</u>	<u>0.5</u>	<u>0.6</u>
West Germany	<u>0.1</u>	<u>NEGL.</u>	<u>0.2</u>	<u>0.1</u>
Other	<u>0.1</u>	<u>0</u>	<u>0</u>	<u>0</u>
Japan	<u>1.2</u>	<u>2.9</u>	<u>3.2</u>	<u>3.3</u>
Other ^{2/}	<u>0.9</u>	<u>0.1</u>	<u>0.7</u>	<u>0.8</u>
Exports to hard currency countries	<u>6.1</u>		<u>8.7</u>	<u>8.4</u>
Hard currency earnings (\$ million)	<u>74</u>		<u>238</u>	<u>385</u>
IMPORTS				
Total	<u>6.8</u>	<u>7.1</u>	<u>9.7</u>	<u>9.8</u>
Poland	<u>6.5</u>	<u>7.1</u>	<u>9.7</u>	<u>9.8</u>

1. Yugoslavia, North Korea, Cuba, Mongolia.

2. Egypt, Greece, Algeria.

SOURCE: Ministerstvo Vneshnei Torgovli SSSR, Vneshnyaya Torgovlya SSSR za 1965, 1970, 1974, 1975 god, Moskva.

APPENDIX A

TABLE 4

USSR: COKE TRADE
(Million metric tons)

	<u>1965</u>	<u>1970</u>	<u>1974</u>	<u>1975</u>
EXPORTS				
Total	<u>3.8</u>	<u>4.2</u>	<u>4.6</u>	<u>4.2</u>
To Communist countries	<u>2.7</u>	<u>3.1</u>	<u>3.5</u>	<u>3.4</u>
Eastern Europe	<u>2.7</u>	<u>3.0</u>	<u>3.2</u>	<u>3.2</u>
Other ^{1/}	NEGL.	<u>0.1</u>	<u>0.3</u>	<u>0.2</u>
To non-Communist countries	<u>1.1</u>	<u>1.1</u>	<u>1.1</u>	<u>0.8</u>
Western Europe	<u>1.0</u>	<u>0.9</u>	<u>0.9</u>	<u>0.7</u>
Austria	<u>0.1</u>	<u>0.1</u>	<u>0.1</u>	<u>0.1</u>
Finland	<u>0.5</u>	<u>0.6</u>	<u>0.6</u>	<u>0.6</u>
Sweden	<u>0.1</u>	<u>0.1</u>	<u>0.2</u>	NEGL.
Other	<u>0.3</u>	<u>0.1</u>	NEGL.	<u>0</u>
Algeria	<u>0</u>	NEGL.	<u>0.1</u>	<u>0.1</u>
Other	<u>0.1</u>	<u>0.2</u>	<u>0.1</u>	<u>0.1</u>
Exports to hard currency countries	<u>0.5</u>	<u>0.3</u>	<u>0.4</u>	<u>0.2</u>
Hard currency earnings (\$ million)	<u>8</u>	<u>9</u>	<u>13</u>	<u>16</u>
IMPORTS				
Total	<u>0.7</u>	<u>0.7</u>	<u>0.7</u>	<u>0.9</u>
Poland	<u>0.7</u>	<u>0.7</u>	<u>0.7</u>	<u>0.9</u>

1. Yugoslavia, Mongolia, North Korea, Cuba.

SOURCES: Ministerstvo Vneshnei Torgovli SSSR, Vneshnyaya Torgovlya
SSSR za 1965, 1970, 1974, 1975 god, Moskva.

APPENDIX B

USSR: ENERGY CONSUMPTION, GROSS NATIONAL PRODUCT, AND THE ENERGY/GNP RATIO

Year	Energy Consumption (Million Metric Tons of Standard Coal Equivalent ^{1,2})	Gross National Product		Energy/GNP Ratio (Kilograms per US \$ ³)
		1950	1955	
		1956	1957	
1955	331	497	497	1.72
1956		528	528	
1957		578	578	
1958		615	615	
1959		649	649	
1960		678	678	
1961		N.A. ⁴ /	757 ⁴ /	N.A.
1962		834 ⁴ /	834 ⁴ /	1.87
1963		868 ⁴ /	868 ⁴ /	1.85
1964		898	898	1.93
1965		952	952	1.90
1966		999	999	1.91
1967		1,045	1,045	1.94
1968		1,099	1,099	1.92
1969		1,119	1,119	1.93
1970		1,180	1,180	1.93
1971		1,251	1,251	1.83
1972		1,314	1,314	1.85
1973		1,372	1,372	1.88
1974		1,440	1,440	1.90
1975		737	737	1.95

1. Coal with a heat value of 7,000 kilocalories per kilogram.
2. Data for 1950 and 1960-74 from the Statistical Yearbook Narodnoye khozyaystvo SSSR v 1974 g., Moscow, 1975 and from earlier issues of this yearbook. Data for 1956-59 calculated from production data in the 1960 issue of this yearbook and from foreign trade data in Vneshnyaya torgovlya za 1955-1959 gody, Moscow, 1961. Figure for 1975 estimated.
3. Estimated. Market prices, with conversion to US dollars via a geometric mean valuation.
4. Adjusted upward from published data, which did not include hydroelectric power for 1962